



HISTORICALLY BLACK COLLEGES AND UNIVERSITIES

NASA TECHNOLOGY INFUSION

ROAD TOUR



AND MINORITY-SERVING INSTITUTIONS

University of Hawaii at Manoa

Hawaii Space Flight Laboratory

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Director, HSFL & HSGC

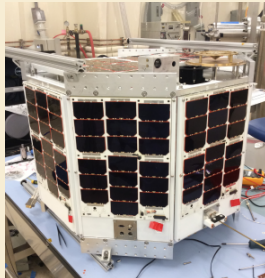


Office of
Small Business
Mentor-Protégé Program

HSFL - Major Project Elements

Spacecraft

- Partner with NASA Centers and others to advance small spacecraft design.
- Design, build, launch, and operate 1-120 kg small satellites for science and education tasks.
- Support technology validation missions as well as other University missions.



Integration and Test

- Clean rooms in UH/POST are used to assemble & test satellites
 - Systems integration
 - Thermal-vacuum testing
 - Vibration/shock testing
 - Payload spin balancing
 - Attitude control testing



Instruments

- The HSFL can call on a diverse group of instrument-developing faculty from HIGP and SOEST.
- A number of businesses in Hawaii also develop a wide array of instrumentation. The HSFL will partner with these organizations to provide technology demonstration opportunities.
- NASA Centers (Ames and JPL) are interested in joint technology missions.

Launch Vehicle and Launch Support



Pacific Missile Range Facility (PMRF)

- Local launch facility and mission support
- Modify existing PMRF launch pad for rail-fitted and modified VAFB Scout launcher.

Kauai Test Facility (KTF)/ Sandia National Lab

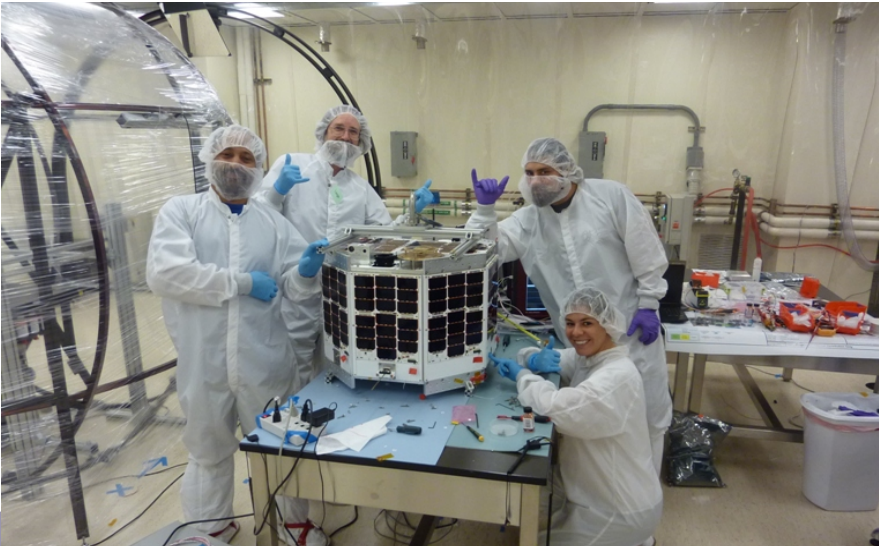
- Experience with solid rockets and missile design. Use Super-Strypi launch vehicle.
- Can lift ~270 kg (594 pounds) to low-Earth orbit (400 km).
- Heritage working with PMRF as on-site vehicle integrator and launch agent.

Ground Station & Mission Operations

- UH/HSFL maintains UHF/VHF receiving stations with Kauai CC and Honolulu CC staff.
- Ground station provides command and control broadcast as well as data downlink capabilities.
- Mission Ops Center POST 5th floor using COSMOS software.



ORS-4 Mission: November 3, 2015



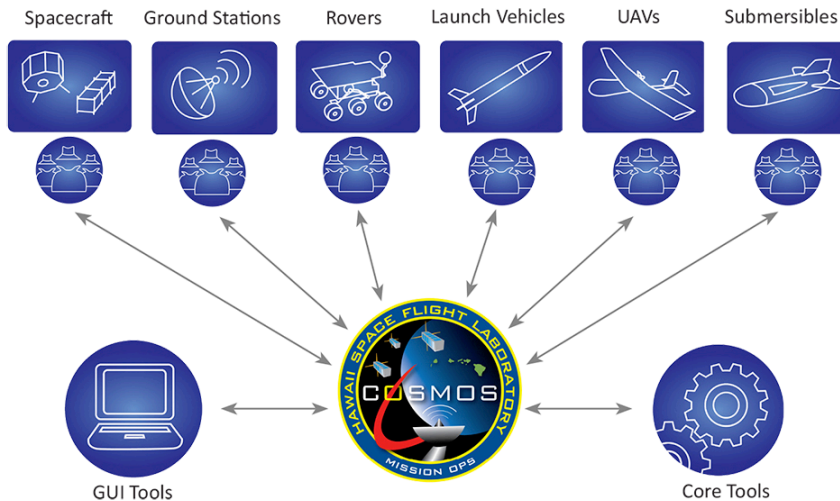
- HSFL mission partner for rail and microsat development.
 - Largest rail launcher in the world built and successful
 - 3 new rocket motors developed in strategic alliance agreement with Aerojet-Rocketdyne.
 - HiakaSat 50-kg microsat delivered by NASA and Air Force standards.
- ORS-4 terminates ~60 seconds into flight
 - 1st stage motor issue
 - X-Bow schedules 2nd flight for 2018.
- ORS-4 Takeaways:
 - 130 **Hawaii** students receive training/experience with HiakaSat
 - HSFL has full test and support capabilities for future satellite work.
 - Working with State and private companies on commercial equatorial and polar small launch from Hawaii. Orbital capability for under \$15M.

Univ. Hawaii – Unmanned Aerial Systems

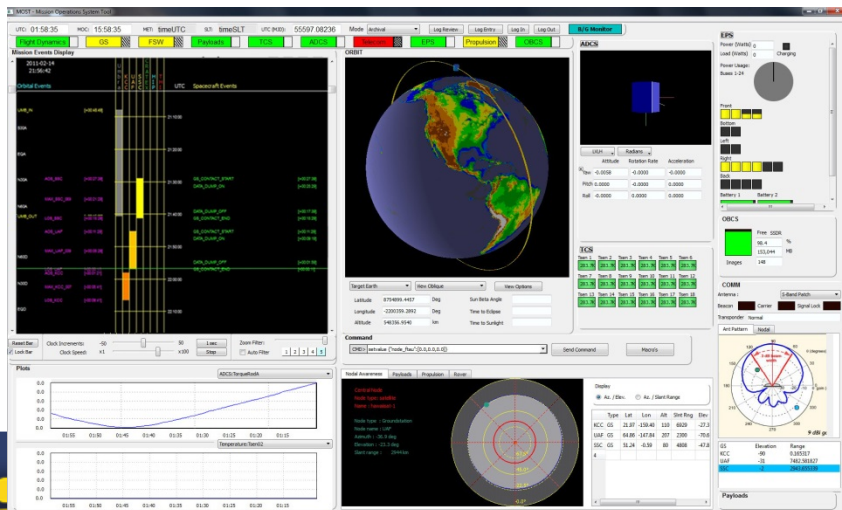
- Hawaii is one of six FAA-Approved UAS (aka “drones”) test sites.
- Authorized through 2021, we’re considered an “extreme environment site”.
- Managed by UH’s Applied Research Lab.
- FAA Challenges include: Extended-range operations beyond line-of-sight, cluster-operations, nighttime operations, science instrument development.
- Building from our strengths:
 - Monitoring active volcanoes on Big Island
 - Coral Reef health
 - Invasive species (e.g., Ohia Rapid Death)
 - Studying Largest Marine Sanctuary on Earth
 - Papahānaumokuākea



Mission Operations Support



- Comprehensive Open-architecture Solution for Mission Operations Systems (**COSMOS**)
- Software framework to support spacecraft mission operations
- Set of tools:
 - Mission Planning & Scheduling Tool (MPST)
 - Mission Operations Support Tool (MOST)
 - Ground Segment Control Tool (GSCT)
 - Data Management Tool (DMT)
 - Flight Dynamics Tool (FDT)
 - Analysis Tools
 - Test Bed Control Tool (TBCT)
- Open architecture to enable modifications and adaptation to new missions and MOCs
- User-friendly interfaces and short learning curves for users and software integrators



HSFL R&D Mission Development



Vibration and Shock Table

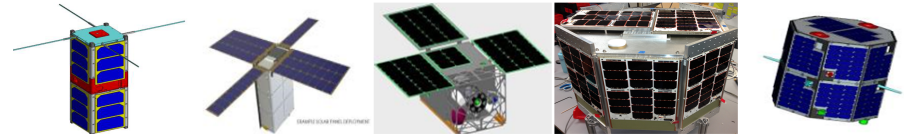
- Tests objects 1.2m x 1.2m
- 5-2200 Hz to 7000 kgf; 14000 kgf shock



Spin Balancer



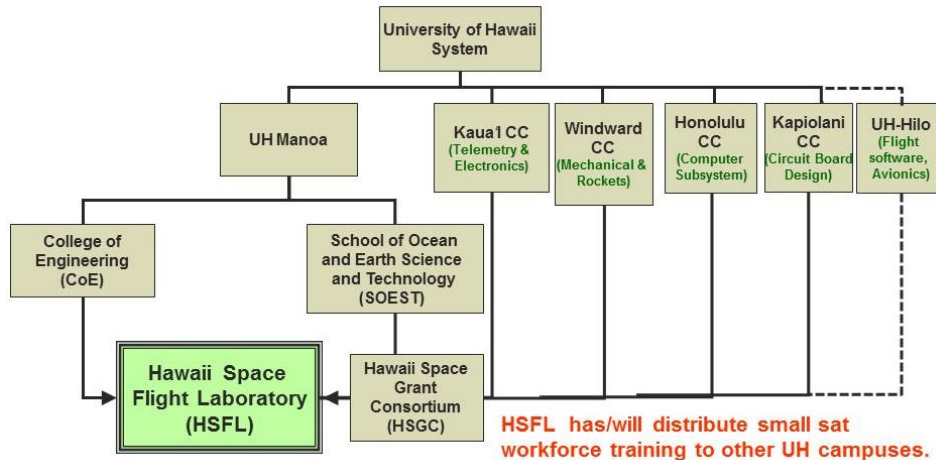
ADCS Test Facility
Air-bearing platform for 150 kg
Magnetic Field, Sun, GPS
simulations



Size	3U	6U	12U	50 kg	100 kg
Pointing	1° - 5°	<1°	<1°	<1°	<1°
Comm.	UHF, VHF, (S-Band, X-Band)	UHF, VHF, S-Band, X-Band	UHF, VHF, S-Band, X-Band	UHF, VHF, S-Band, X-Band	UHF, VHF, S-Band, X-Band
Payload	1 kg, 1W	2 kg, 5W	4 kg, 10W	10 kg, 10-20W	30 kg, 20-30W
S/C ROM	\$0.7M	\$1.3M	\$2.5M	\$3.5M	\$6M
1-Year Mission*	\$1.5M	\$2.3M	\$4.0M	\$6.5M	\$12M

* Includes Rocket Lab Electron launch and 1 year Mission Ops

Engaging the UH System: Workforce Development

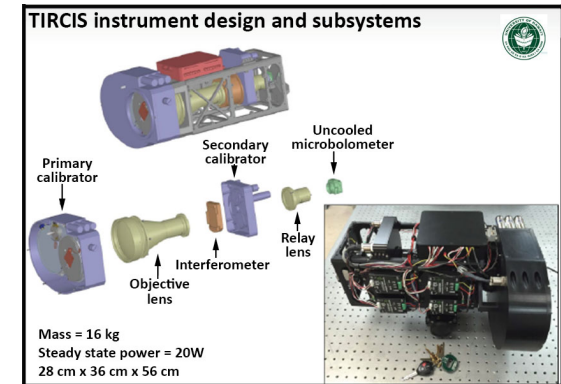


- Distributed campus approach to workforce development.
 - **CC's provide technical Associate Degrees**
 - **4-yr provide depth in Bachelor's Degrees**
- Present Status and Future Plan:
 - **Kauai:** Small satellite communications and electronics fabrication
 - **Maui:** Space debris surveillance, CanSat.
 - **Hawaii:** Software development for small satellites, test bed for lunar rovers
 - **Oahu:** CanSat and suborbital mission development at HCC, WCC, KapCC
 - **HIGP/UH-Manoa:** Planetary Exploration Technology (PET) Minor.
 - Current plan includes 11 distinct course offerings, with a mixture of basic science and technology/engineering focused classes (1. History of Solar System Exploration, 2. Cosmochemistry, 3. Hawai'i as a planetary analog, 4. Planetary surfaces and atmospheres 5. Planetary interiors 6. Extraterrestrial materials analysis 7. Remote sensing of planetary surfaces, 8. Instrumentation for planetary exploration, 9. Space mission design, 10. Space mission operations, 11. Senior Capstone Mission).

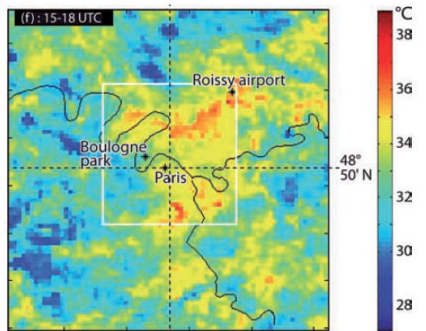


Univ. Hawaii – Small Satellite Mission Concepts

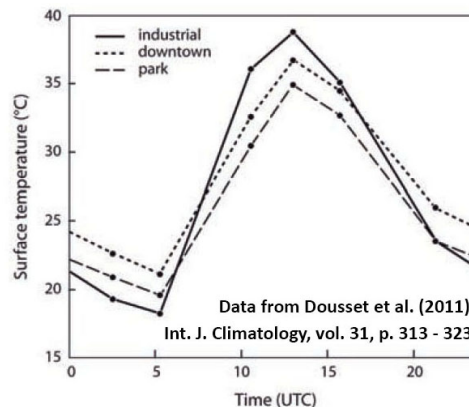
RockSat – Single instrument lunar orbiter mission to collect compositional and thermophysical information about the Moon at unprecedented high spatial resolution



**UH-built hyperspectral imagers
in VIS/near-IR and TIR**



Daily temperature variations in Paris



Heat Island Imager Satellites (HII-Sat)



CRESPO (the Coral Reef Ecosystem Spectro-Photometric Observatory)